An exploration of the boat form and the element of water through craft based sculptural works.

by

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Declaration of Originality

‘This thesis contains no material which has been accepted for a degree or diploma by the University or any other institution, except by way of background information and duly acknowledged in the thesis, and to the best of my knowledge and belief no material previously published or written by another person except where due acknowledgement is made in the text of the thesis, nor does the thesis contain any material that infringes copyright.’

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Preface

Throughout my life I have had an intrinsic connection with the element of water. Since birth and until adulthood I resided within close proximity to the ocean environment, the salt impregnated air filling my lungs and the rhythmic song of the waves crashing onto the shore being a source of comfort rocking me to sleep in the same way that some children find the same comfort in simple melodies. Before I even understood the notion of what the ocean was it was becoming an intrinsic part of my being.

The curiosity of youth soon ensured that I succumbed to the pull of the ocean, enticing me to explore this fascinating environment more closely. The waves became a playmate pushing me around with effortless force and the plethora of creatures that dwell below the surface drawing me back to observe the way that they thrive in this unforgiving environment.

One of the best methods for humans to explore and traverse the element of water is by boat so unsurprisingly from early on the boat became a significant part of my life. Becoming the proud skipper of a tiny wooden sailing dinghy lovingly restored by my father at an early age was a defining moment in regard to my connection with boats and the ocean and this still resounds today.

In this project I have sought to express my deep intrinsic connection with the boat and the element of water by creating sculptural forms from wood by synthesising boat building methods with my skills as an established furniture designer and maker.

Abstract

Topic: An exploration of the boat form and the element of water through craft based sculptural works.

This project seeks to communicate through sculpture different facets of humanity's interaction with the ocean, ranging from water as calm and reflective to water as a turbulent force. In doing so it reflects on both our intimate connection with water as well as our vulnerability in the face of its elemental power, using the boat form to explore these themes.

The works are a direct result of my own lived experience, that experience being a lifetime connection to boats and the marine environment. Inspired by my experience as a diver immersed in the ocean being twisted and bent by the currents, I have imagined the boat form losing its buoyancy and sinking below the surface, losing its rigidity and yielding to the forces of the sea. To communicate this more clearly, the boat has been distilled down to its archetypal form by removing all elements aside from the hull as the hull is the element which intimately and directly connects with water. The reductivist nature of Constantin Brancusi's sculptural works has informed my project in this regard.

Technique is key to my practice with my background as a furniture designer and maker and through this project the potential benefits and disadvantages of integrating digital technology into a traditional craft practice by digitizing the previously analogue cold moulding method is explored.

Practitioners who take a craft-based approach such as Matthias Pleissnig, Wendell Castle and Joseph Walsh have all informed my practice in the way that they create a synthesis of art, craft and design in their work My intent for this project is to demonstrate through taking a measured and considered approach to the implementation of digital technology, craftspeople can utilize the power of these tools to create more ambitious projects without compromising the integrity of their work. The final exhibition is comprised of three archetypal forms in space which respond to the contrasting characteristics of water through the boat form. They are intended to evoke a sense of our vulnerability in the face of the elemental forces of nature as embodied in the element of water which can both sustain life but also take it. The practical results were that it was demonstrated that the cold moulding has the potential to be successfully adapted for smaller scale projects with the assistance of digital fabrication techniques.

Introduction

The inspiration for this project has its roots in my connection to boats and the element of water. Having been introduced to both at an early age, boats have formed an integral part of my life and a way to access the marine environment. My experiences however are not just limited to the surface of the water but also encompass its depths through the activity of scuba diving. It is here below the waves where, fully immersed in water, I have gained a greater understanding of, and connection with, how water works. While on a boat there is still a degree of separation between water and human, when I am totally immersed in the watery depths there is no separation. I become one with the water and fully exposed to its forces. When diving in an area where there are waves, or the sea is surging, the way in which water moves in a circular motion is amplified. It repeatedly seizes my body in its immense grasp and seeks to twist me into a tumbling motion back and forth. An important piece of scuba diving equipment is the buoyancy compensating device which is a vest worn by the diver which has an air bladder contained inside. This bladder is connected to the air tank enabling air to be pumped into it while underwater. By pumping just, the right amount of air into the vest the diver can perfectly balance the forces of buoyancy and gravity, so that they neither rise nor sink in the water column. This is defined as neutral buoyancy, and it is a wonderous sensation to weightlessly glide through the water observing the array of flora and fauna while being gently pushed and pulled by the currents. It is these experiences that have formed the inspiration for this project. I have taken a boat form, and then imagined it descending into

the ocean until fully immersed, losing its rigidity, becoming pliable and twisted by the swirling currents which forms the basis for the final works

Three different states of water have inspired the three final works communicating its nature, these being for the purposes of this investigation: reflective water; deep water and powerful water. Reflective water's mirror-like properties are examined through the story of Narcissus; used as an example of its referencing in art and mythology. Deep water has an absorbent all-consuming nature and has a duality in that it can be viewed as a place of cold abyssal darkness. This darkness has connotations with death but also as a place teeming with life which provides shelter. Water holds an immense power that can be both destructive and regenerative. The power of water has been used as metaphor by writers and artists to communicate the vulnerability of humans to the natural environment.

While influenced by my background as a furniture designer, the works in this project are purely sculptural, drawing on the form of the boat, which has also informed my previous practice. My fascination with boats has extended from simply being a user, enjoying the aquatic environment, to a deep curiosity of boat building techniques. I had the pleasure of building a wooden dinghy some years ago, and the experience was transformative to my furniture design practice as well as to this current project.

The first chapter of the exegesis introduces and examines the key themes of the project. Here I discuss my fascination with boats in the context of the wider cultural connection and historic significance of the boat, providing examples of its significance to peoples of many cultures and its veneration and use in religious ceremonies and in mythology. An overview of the history of the boat and its development will be given from its most primitive form as a block of buoyant wood through to what we understand the boat to be in contemporary times as a shell-like vessel form. Following on from this, will be a discussion of the sources of appeal of the boat as an aesthetic form, drawing on the book *Curvilinearity in Architecture: emotional effect of curvilinear forms in interior design.* This will be followed by a discussion of the three states of water which are evoked by my sculptural works: reflective water; deep water and powerful water. *Water and Dreams: An essay on the imagination of matter* is the most significant literary source in regard to the differing states of water which assisted me in expanding on the three chosen states while I have also provided examples of my own personal experiences with the element of water. Finally, I discuss my design philosophy. As a fine furniture maker, the notion of craftsmanship and its importance to my work have been cornerstones of my practice and continue to be so in this project. The idea of traditional craftsmanship in contemporary times has been challenged by the advent of digital technology where there has tended to be a polarisation between the old ways and the new. I have sought however, to develop a synthesis between my traditional analogue training and

contemporary digital design and fabrication techniques where both benefit from the strengths and counter the weaknesses of the other which is demonstrated in the finished works.

To provide a contextual basis for my project the work of four artists and designers has been examined in the second chapter. The four are Joseph Walsh, Matthias Pliessnig, Wendell Castle and Constantin Brancusi. Joseph Walsh is of relevance to this project because of the way in which he has taken the well-established technique of strip lamination and adapted it to be able to make his complex sculptural furniture. Inspired by the forms found in nature, he utilises digital technology sparingly as a design aid to simplify the calculation of these complex forms. Matthias Pliessnig, also a furniture designer, has taken inspiration from boat building in the construction technique he implements in his work. By bending thin strips of steam bent oak over a framework of ribs he creates curvaceous, undulating bench seats which are reminiscent of the swells of the ocean. Wendell Castle was an established designer maker who began making works in the 1960's up until his recent passing. Castle was known for his hand carved sculptural wooden furniture and sculptures in which their hand-crafted nature could be distinguished. He was able to integrate digital design and fabrication into his established traditional practice which enabled him to undertake more ambitious projects. Constantin Brancusi, the well-known sculptor, had the ability to pare his subjects back to their most elemental

archetypal form. By removing all superfluous detail he was able to reveal the very essence of his subjects and this has informed my minimalist approach.

The methodology for the project is described in the third chapter. The techniques that I developed, adapted and utilised for the project –namely the cold moulded wood lamination method, which is a technique where thin layers of timber veneer are laid over a male mould and then glued together forming a rigid shell like structure – will be explained beginning with a historical background of this method and concluding with a description of how it has been adapted to my own needs. In this chapter, the symbolic significance of the three works produced is also addressed. These works are named: *Reflection, Depth* and *Power*. *Reflection* explores the notion of reflection and modern society's narcissistic attempt to achieve the elusive and impossible state of perfection. *Depth* is inspired by deep abyssal water and its duality of being dark, and consuming while at the same time a place where life thrives. *Power* explores the monumental force of water, and the way in which it can overpower any human construct. The form in this work has been broken apart, losing its structural rigidity, its skeletal appearance referencing the destructive power of water.

Chapter 1

Introduction

In the section above, I introduced my fascination with boats and the ocean, which stems from a lifelong connection. The ocean is a place to which I am able to align my feelings and emotions: I have found solitude in its calm tranquillity; it has, with its monumental power been a place of awe; it has been the source of joyful memories while sadly also being a place of tragedy due to the loss of a close friend to its depths. I see the ocean environment still as a place of mythology and superstition, an alien environment where we are unable to survive for more than a fleeting moment.

In this chapter I will discuss the boat in a historical context providing examples of its veneration and cultural significance along with an overview of the evolution of the invention of the boat. The aesthetics of the boat and the functional requirements that dictate its curvaceous form will be examined alongside examples that demonstrate the tendency to anthropomorphise the form. The element of water and its properties will be discussed as it pertains to this project, focusing on the three specific states of water that I am responding to in my works: reflective water, deep water and powerful water. Reflective water has strong connotations of tranquillity and introspection, deep water is symbolic of absorption and death while powerful water evokes a sense of vulnerability to the elements through movement and monumentality. Finally, the notion of craft in the digital era and the benefits and issues arising from integrating digital

technology into a craft practice will be explored along with how this integration has informed my own practice.

The Boat

Cultural Significance

Boats have been an intrinsic part of human culture for millennia. Indeed, they are the oldest means of transport known to man (ed. Hansen 1968). So important have boats been to cultures that models placed in tombs as burial gifts or displayed as votive offerings to the various gods have been found in tombs and sacred places throughout cultures (ed. Hansen 1968). Full sized boats have been discovered in burial mounds of Viking chieftains. The best-known example of this is the Gokstad ship which was discovered in Norway and was built in approximately 890AD. Also placed alongside the body in the Gokstad ship were weapons, animals, utensils and valuable burial gifts.

Fig. 1. Gokstad Ship

A stunning example of a votive offering is the Broighter boat, which was part of the Broighter hoard, an Iron Age collection of offerings discovered on the shores of Lough Foyle in Northern Ireland. The element of the Broighter boat that most appeals to me is what I consider to be the archetypal form of the boat. It is the embodiment of the boat in the way that each end begins as a point which gradually tapers out symmetrically towards its centre which is its widest point. Boats vary wildly in their differing shapes depending on their intended use, but if you pare them back to their basic form they are in principle the same with the bow and the stern tapering to an edge to slice through the water and the mid-section being the widest most bulky point of the hull which provides buoyancy and stability.

Fig. 2. Broighter Boat.

For my project I am utilising this form as the basis of my works. My rationale for this approach is that to best communicate the connection between the boat and

the element of water, I have found that simplicity and purity of form is the most appropriate approach.

Mythology and the boat

In several cultures such as ancient Greece it was believed that when a person died their soul did not immediately go to the afterlife but embarked on a transitory journey from the world of the living to the world of the dead. (Lewis 2001) The boat was a frequent mode of transport to the afterlife amongst seafaring cultures such as the Vikings who placed their most important members into a boat before the boat and body were buried together.

An example of a boat being used as a conduit to the afterlife is in ancient Greek mythology where the souls of the dead were greeted by Charon, the grim boatman, who transported the dead in his ferry across the river Styx to Hades. (Lewis 2001)

The History of the boat

The boat is an ancient invention with its beginnings going back to prehistoric times. (Hornell 1946, p.2) It is most likely one of human kind's earliest tools which was created when humans discovered that materials such as wood could provide floatation. By resting the chest on a small block of buoyant wood and

kicking their legs, humans would have discovered that they could propel themselves through the water enabling the traversing of waterways (Hornell 1946, p. 2). The most famous of the wooden float type craft is the Hawaiian surfboard which, apart from being made from synthetic materials these days, has changed minimally over time. An advancement on the wooden block float was the inflated skin. This craft was made by inflating an animal skin from a goat or cow which was lain upon or ridden astride. A sculpture dating from the time of Ashur-nasir-pal III, The King of Assyria who reigned from 883 to 859BC depicts soldiers astride animal skin floats swimming across a river to attack an enemy force (Hornell, 1946, p. 6). The Mongol troops of Genghis Khan carried a water tight animal skin as part of their field equipment enabling them to rapidly cross rivers and not slow their advance by having to construct bridges or barges (Hornell 1946, p 8). The relevance of these craft to the archetypal boat form, as we know it, is in the way that all are based on the principle of displacement where the vessel displaces water with air, making them buoyant.

The boat as a vessel form.

The oldest surviving boat is the Pesse dugout canoe which is estimated to be 10,000 years old. Dugout canoes were made by removing the bulk of the material from the centre of the log while leaving the ends and the sides solid, thus creating a simple vessel form that could be sat in and paddled. The method for removing the wood from the centre of the log began with using a carefully controlled fire to burn the excess material out. With the advent of more

sophisticated tools such as axes, the excess material was able to be scooped out to achieve the desired shape. Dugout canoes were popular in areas that had access to large trees such as in the tropical rainforests and parts of Europe.

In areas without large trees, boats were made of other available materials such as bark, a well-known example of the use of bark being the birch bark canoes of the Native American tribes, where the bark of the tree was peeled off in one layer and then stitched together at the ends to create a lightweight and rigid canoe. In areas where there were no trees such as in the Arctic, the Eskimo people used animal skins to build their kayaks (Hornell 1946, p. 155). The Tasmanian Aboriginals also utilised bark to build their canoes by bundling up pieces of bark, which were then bound together into a stable raft like form. They are strongly reminiscent of the archetypal boat form in the way that they are at their widest and most bulky point towards the midpoint of the craft, which provides stability and greater flotation, then taper inwards and curve upwards to a point at each end which enables the raft to travel more efficiently through the water in a straight line. Reeds were bundled up into boat shaped vessels in regions where trees were scarce such as in the Middle East and other low-lying marsh lands, while bamboo or small diameter logs were lashed together to form primitive craft which were likely to have been in use before the Pesse canoe was built. (Hornell 1946, p.39)

The difference between the early primitive boats and the wooden boats of today is slight. The principles remain the same with materials such as wood or bark being used to create a watertight hull which can carry a load by displacing water. Through countless small advancements each generation has learned how to manipulate timber and other materials to maximise their strengths and to minimise weaknesses. So, rather than carve a hull out of an entire log to create a dugout canoe which creates a hull that is heavy and cannot be shaped into a hydrodynamic form, craftspeople worked out how to cut a log into a series of small components such as the planking and frames which were then assembled into a lightweight hull with hydrodynamic properties.

The Boat as an Aesthetic Form

A boat possesses an intrinsic beauty in its form, which is dictated predominately by its function. It is this requirement that necessitates that the hull should be smooth and streamlined with no sudden protrusions. The hull needs to be strong in its construction to withstand the powers unleashed by the elements but at the same time it needs to be light weight requiring careful design. A boat needs to interact with the environment, working with nature in a constant balancing act. Designers Barber Ogersby took reference from the forms of yachts and the hidden design of these structures in their exhibition Ascent. (Barber & Ogersby 2011) Of all the inventions mankind has created it is the yacht which most closely reflects the inventions of mother-nature. Nineteenth century sculptor Horatio Greenough wrote in his book *Form and Function, Remarks on Art, Design, and Architecture*:

> Observe a ship at sea! Mark the majestic form of her hull as she rushes through the water, observe the graceful bend of her body, the gentle transition from round to flat, the grasp of her keel, the leap of her bows, the symmetry and rich trajectory of her spars and rigging, and those grand wind muscles, her sails....Here is the result of the study of man upon the great deep, where nature spake of the laws of building, not in the feather and flower but in winds and waves… (Greenough, 1947 p. 60)

During Greenough's time the majestic form of the hull that he spoke about was the result of a practical solution. This was, making a vessel travel through water as efficiently as possible, the inherent beauty of its hull was a secondary result.

However, during the art deco period of the 1920's to 1930's dynamic curvaceous forms began to be used by designers as much for their aesthetic value as for their practical applications.

Streamlining

Known as the streamlined style it was inspired by the philosophy of creating forms, which moved through the fluids of air and water as efficiently as possible. By making an object smooth, with the intersections of components blending gently and seamlessly greater efficiency could be achieved. The smooth flowing aesthetic that was created as a by-product to this research was adopted by the designers of everyday objects such as furniture, household appliances and architecture. Below is an arm chair and Ottoman designed by Donald Deskey, who was a noted designer of the art deco period. This work exhibits the characteristics of the streamline style with its symmetrical curves and radiused bends. The use of new materials such as chromed steel was popular and the metal strips along the front of the armchair have a machine-like quality.

Fig. 3. Donald Deskey, Arm Chair, c.1930.

Donald Bush explains in his work *The Streamlined Decade 1975,* that streamlined forms were linear in nature with smooth surfaces and radiused edges. They were governed by the principle of absorption, whereby each of the components partially merged into one another with seamless connections, and without embellishment so as to give the appearance of being able to penetrate air or water efficiently in resemblance to natural forms (Bush 1975, p.1).

This is evident in the boat's form which has its natural counterpart in the body of a fish. The similarity in form between a boat's hull and a fish's body is apparent upon viewing and boat designers and engineers have been influenced and inspired by fish throughout history. Sir D'Arcy Wentworth Thompson, the biologist who held that life forms have a mathematical basis, supported the notion that humankind should take reference from nature when designing machines. In his book *On Growth and Form* he states:

> The naval architect learns a great part of his lesson from the stream-lining of a fish; the yachtsman learns that his sails are nothing more than a great bird's wing, causing the slender hull to fly along. (Thompson 1945, p. 961)

The Curvilinear Form

Why it is appealing

According to the author of *Curvilinearity in Architecture: emotional effect of curvilinear forms in interior design* Madani Nejad, the curvilinear form has great aesthetic appeal, the psychological effects of this form in art and design is a topic which has not been widely researched. The above-mentioned thesis was a study conducted to investigate this. A group of twelve un-named prominent architects, who are known for their use of curvilinear forms in their work, were interviewed to gain an understanding of why they are drawn to use them. The assumption amongst these architects was that free-flowing curvilinear forms are sympathetic to the body, mind and spirit. (Nejad 2007). Following from these interviews, a study was conducted where a test group was shown a series of perspective drawings of an interior space which gradually changed from rectilinear to curvilinear in form. There were two groups of test subjects with one group comprised of architects and the other of non-architects and their emotional response to these forms was recorded and collated. (Nejad 2007).

A summary of the results is as follows:

For the emotional variables: Unpleasant-Pleasant, Depressing-Elevating, Stressful-Relaxing, Unfriendly-Friendly, Impersonal-Personal, Unsafe-Safe there was a modest positive preference toward the curvilinear form.

For the variables: Simple-Complex, Not-Mysterious-Mysterious and Masculine-Feminine there was a strong positive preference toward the curvilinear form.

The results of this study demonstrated that there is in an overall positive reaction to curvilinear forms when compared to the rectilinear forms by a varied group of individuals. Of greatest surprise to the author was the strong consensus by test subjects that the curvilinear form is interpreted as being feminine in nature (Nejad 2007).

The anthropomorphising of the boat.

Likewise, boats have historically been referred to as 'she' and are given female names. One just needs to look around the docks to see the array of craft with female or feminine names. Whether this practice developed as a result of the boat exhibiting a curvaceous aesthetic reminiscent of the female form is an interesting notion to consider. Jung argued that the vessel form can be a positive symbol of the mother archetype with the womb being one of his examples of the way in which the vessel forms a protective embrace around its contents. (Jung 1972, p.15) When I consider my own language in describing my work, I frequently anthropomorphise it by using terms such as curvaceous and sinuous, and in the boatbuilding trade the word 'buttock' is used to describe the most curvaceous part of the hull, and 'rib' is used to describe a structural member. This anthropomorphising of the boat by myself is an unintentional action; however, sailors have been doing it for centuries at the least. Peter D Jeans provides three possibilities into the practice of the feminisation of the ship in his book *Seafaring Lore and Legend*. His first example touches on the humanity of seafarers in the way that within their hardened callous exteriors, sailors still

appreciated the beauty of their ships under sail. (Jeans p. 309) Jeans' second example describes the maternal qualities of the boat in the way that it is a provider of shelter, safety and sustenance and at times self-sacrificing in the same ways that a mother can be. (Jeans 2004, p.309) His final explanation touches on the mythological importance of the boat in many cultures citing the example of the ship launching ceremony where a bottle of wine is broken over its bow as an offering to the god of the sea Poseidon, presenting the ship to him as a bride. (Jeans 2004, p. 310)

Of course, the boat only exists because of the element of water and our need to traverse it and utilise its resources. As we are terrestrial beings our ability to travel through water is limited, so the boat was created as a tool to resolve this issue. In the next section, I will explore more deeply the properties of water and introduce the three states of water that I have used as inspiration for my works.

The Element of Water

Water in its liquid state can take on many forms and for this project I am creating three works which explore water in different forms: reflective water, deep water and powerful water. Many artists and writers have explored water in its many forms, from Claude Monet, who explored the reflective nature of water in painting in works such as *Gondola in Venice, 1908,* to William Shakespeare who used the monumental power of the ocean in his play *The Tempest*. These artists and writers have found a deep pool of inspiration in the varied states of water using them as metaphors to encounter feeling. The philosopher Gaston Bachelard explores the materiality of the elements of water and its meaning when appearing in our imaginings in his book *Water and Dreams: an essay on the imagination of matter* (1942).

Reflective Water

Bachelard writes of water that is calm and tranquil in nature having a reflective quality which is reminiscent of the mirror (Bachelard 1942, p. 21) drawing a parallel to the story of Narcissus from Greek mythology, the son of the river god Cephissus. The relevance of this myth is how Narcissus came upon a pool of water and while drinking from the pool notices his own image being reflected. He becomes seduced by his own image, becoming oblivious to the world and the calls of the nymph Echo to stop gazing on the reflection. The result is that he is unable to draw himself away from his reflection and he slowly wastes away. Ovid describes the pool in his poem Metamorphosis:

There stands a fountain in a darksom wood,

Nor stain'd with falling leaves nor rising mud;

Untroubled by the breath of winds it rests,

Unsully'd by the touch of men or beasts;

High bow'rs of shady trees above it grow,

And rising grass and chearful greens below.

Bachelard turns to Shelley to describe the imagining of reflection:

"yellow flowers Forever gaze on their own drooping eyes, Reflected in the crystal calm." (Bachelard 1942, p. 25)

Like Ovid and Shelley, those who live near a waterway understand the power and draw of water when in turmoil or seeking clarity or indeed to 'reflect' on something. I am often drawn to the edge of the shore gazing at the gently lapping waters while my mind ponders whatever it is I am concerned about, hoping that in the water an answer to my problem lies. This is an activity I vividly recall doing frequently in my younger years when I lived close to the sea, perched on a rock entranced by the silvery ever-changing waters of the Derwent River.

Water and ceremony.

Humans have sought answers from the watery ether through divination rituals involving reflective surfaces which have been practiced by cultures for millennia. This practice is known in a wider sense as scrying but when involving specifically water it is referred to as hydromancy which is a way of achieving a state of

trance through staring at reflective water until hallucinations are experienced. (Nelson 2000, p.1) I must admit that while gazing at calm reflective waters I have not hallucinated or been hypnotised, but I have been entranced by it. My thought is that by focussing solely on the water, a kind of meditative state is achieved providing a clarity of thought.

Once one descends through the thin veneer of the reflective surface layer the monumental nature of deep water becomes apparent. In the case of deep oceanic water when the skies are clear, and it is calm the surface becomes a beautiful reflective iridescent blue colour, its clear waters soaking up the sunlight. Once this layer is pierced things change, the bright light of the surface gradually fades away to the darkness of the depths which is the next topic to be examined.

Deep Water

Deep water, Bachelard writes, has the quality of being able to absorb all matter. He says

> *In the presence of deep water, you choose your vision; you can see the unmoving bottom or the current, the bank or infinity, just as you wish; you have the ambiguous right to see or not to see; you have the right to live with the boatman or with 'a new race of fairies, laborious, tasteful, magnificent, and fastidious'*. (Bachelard 1942, p. 50)

Here he highlights the ever changing, multi-dimensional nature of the element of water. On its surface it is able to reflect all that appears above it while at the

same time being able to consume all that descends through its thin silvery layer into its abyssal depths.

As light penetrates deeper into the watery depths, one by one the colours of the spectrum of light are absorbed. The first colour to be absorbed is red. It is no coincidence that many species of fish that inhabit the ocean are coloured various shades of bright red for camouflage. When viewed under the water at depth they appear a blue silver colour blending into the surroundings. The other colours of the spectrum are gradually absorbed by the water with blue being the last to be absorbed before light can no longer penetrate leading to total darkness. Bachelard turns to Allan Edgar Poe in his description of deep water:

> *She is a year nearer unto death; for I did not fail to see that, as she came into the shade, her shadow fell from her, and was swallowed up in the dark water, making its blackness more black. (Bachelard 1942, p. 55)*

The dark side of deep water

Unfortunately, I am able to relate personally to this metaphor, for in my own imaginings, I see my dear friend who was taken by the ocean as he was diving into its depths. After reading Bachelard's chapter I realised that when I imagine the scene, I am always floating on the surface of the ocean looking down into the dark murky waters, my friend in the distance out of reach lies on the seafloor held down by the weight of the sea. Jung argued that deep water, the abyss,

darkness or anything which devours, can be seen as a metaphor for death, representing the negative side of the mother archetype. (Jung 1972, p16)

The light side of deep water

There is a duality to the mother archetype, as it is more often portrayed in a positive light with the sea, a spring and vessel shaped flowers all positive symbols of sustenance and fertility. (Jung 1972, p16-17) Bachelard is in agreement with this and says that throughout literature there are examples of the sea and water being symbols of maternity. To explain this, he again quotes Allan Edgar Poe:

> *The real sea, by itself, would not be enough to entrance humans as it does. The sea sings a song which reaches them on two different levels, the higher and more superficial of which is the less appealing. It is the deeper one...which has from time immemorial...drawn men to the sea. (Bachelard 1942, p. 116)*

By descending into the abyssal depths, the sheer weight of water begins to exert its compressive force which increases the further one descends. Water is a powerful dynamic element and it is this power which is the topic of the next section.

Powerful Water

Water has an immense power that it unleashes in a variety of ways. One of the most dramatic and dynamic examples is when water forms into large waves which throw themselves mercilessly at the craggy shoreline with ground shaking power, endlessly pummelling the craggy shoreline, scouring the monumental and seemingly impenetrable cliffs patiently into tiny particles of sand. I recall in my

childhood when I lived close to the coast being rocked to sleep by the sound of the waves which at times shook our timber house in the still of the night. Still to this day, many years after I moved away from my childhood home, when I am fortunate to stay close to the coast, I find the repetitive rumbling of the waves at night a soothing experience.

Powerful water in art

Katsushika Hokusai, the Japanese artist, created *Under The Wave Off Kanagawa, c. 1803*– an iconic woodblock print of a giant breaking wave towering over a tiny Mount Fuji, "challenging the timelessness of the immortal mountain". (Guth 2015, p. 2) As Guth describes it: "The cresting wave is bound up with elemental, often erotic, mythologies of natural destruction and renewal." (Guth 2015, p. 2) Three small boats rowing head long into the wall of water captures humankind's vulnerability in this monumental environment.

Figure 4: *Under The Wave Off Kanagawa,* Katsushika Hokusai, c.1830.

Personal experience

I have experienced this vulnerability myself while diving during particularly rough weather. With a sense of trepidation being outweighed by my confidence in the ocean I plunged into the ocean from the rocky shore and headed out. All was well until my return when I tried to swim ashore. As the waves got closer to the shore and began to interact with it, the shallowing water intensified the power of the wave. Each time I swam towards the shore a wave would hurl me forwards with great speed towards the rocks. As I got within reach of dry land the same wave that had just helped me would retreat from the shore as a surging wall of water becoming an adversary pulling me back out into open water. After

considerable effort the shore was eventually reached by grabbing hold of bull kelp each time a wave retreated, inching my way to safety with a reminder of the unforgiving nature of the sea. To observe the stormy waters from the shoreline can be an awe-inspiring sight but it is only when fully immersed in them that the true power can be directly experienced.

In the next section, I will discuss my design philosophy and the effect it has on my work with a focus on combining traditional and digital techniques.

Design Philosophy

A commitment to craftsmanship forms an important part of my design philosophy, and my ethos is to thoughtfully create works which are a synthesis of traditional craft and contemporary technology where one supports the other. Richard Sennett succinctly describes craftsmanship as “an enduring, basic impulse, the desire to do a job well for its own sake.” (Sennett 2008, p. 9) He argues that craftsmanship is more of a philosophical approach than simply a learned skill and can be applied to all manner of occupations and tasks not just the applied arts and manual trades. David Pye shares a similar opinion stating “...in workmanship the care counts for more than the judgement and dexterity; though care may well become habitual and unconscious.” (Pye 1995, p.20)

Water as a metaphor for craftsmanship.

A link may be drawn between the three states of water I am examining, what they represent and the notion of craftsmanship. Making objects requires at times deep reflection. In the way that we sit by the water's edge much can be gained by simply sitting by a finished work and mulling over the making process, reflecting on improvements to be incorporated into future works. Deep water can be representative of the embodied tacit knowledge and patience craftspeople develop over a lifetime of work in the way that deep oceanic waters are an ancient slow-moving creation whose currents have formed over time, holding a vast historical knowledge of the environment, which we are able to be access. Powerful water can be a metaphor for the measured application of power required of craftspeople when striking a tool gently with care which removes a small amount of material, in the same way that when a light breeze blows across the surface of the water small waves form which gently lap at the shore eroding away small amounts of sand and grit. When a tool is struck with immense unrestrained force the workpiece is in danger of being destroyed as when a storm takes hold of water large powerful waves are created which can destroy and erode the shoreline.

The notion of craftsmanship

In his book *The Nature and Art of Workmanship* David Pye separates craftsmanship into two parts: the workmanship of risk and the workmanship of certainty. Pye describes the workmanship of risk as using any kind of technique where the result is not predetermined but reflects the tacit knowledge and care

of the maker. (Pye 1995, p. 20) An example of where the workmanship of risk applies to my own work is when I am shaping a curved wooden form to its final shape with hand tools such as rasps, scrapers and finally increasingly finer grits of abrasive paper simply held in my hand which involves considerable care, dexterity and patience. It is this physical connection to the work where the shape of my hands begins to subtly influence the final form of the piece that provides an unmatched level of tactility than which could be achieved solely with machine tools.

Pye describes the workmanship of certainty as found in manufacturers using automated machinery to mass produce works where the result is predetermined. (Pye 1995, p. 20) An example of this approach in my own work is when I utilise a computer controlled cutting machine, known as a CNC router, to accurately carve a mould from a block of wood that I will then use to make one of my works. This approach provides me with a highly accurate foundation from which to develop my projects with the tolerance predefined. Tactility is irrelevant in this instance as the mould is not a part of the complete work. Its task is to hold the timber strips in place while the adhesive cures. The tactility comes from the timber and the finish that is applied. There are cases where the tactility of the mould is important such as in wax casting where the surface finish of the mould is transferred to the finished work during the making process.

Craft and technology

In Pye's description of the workmanship of certainty he is concerned with repetitive operations using machinery or purpose-built tooling such as cutting multiple circles to the same size for example, which requires minimal thought

and input from the worker. This is a point of difference to my practice where I am utilising machinery to construct complex, unique and one-off components also with a near-certainty of success. I say near certainty because even sophisticated Computer Aided Design and Computer Aided Machining technologies or (CADCAM) and their skilled human controllers are not infallible. British Designer Gareth Neal writes in regard to Pye's view of workmanship that CADCAM tools should be considered an extension of our hands even though there is a physical disconnection in contemporary craft. (Neal, 2018) He goes on to say that: 'The workmanship of risk means crafting or manufacturing at the far boundaries of ability or skill with new or unexplored processes or ideas. As opposed to the workmanship of certainty, which applies to tried and tested methods where results can be assured and risk can be minimised.' (Neal, 2018)

This difference lies, I suspect in the fact, that Pye's book was first written in 1968 and a revised edition re-published in 1995, which while not long past the computer numerically controlled technology that I am utilising was in its early stages of development and lacked the capabilities of current equipment. However, the principle of good craftsmanship remains the same as it has applied to countless generations of workers. It is simply the tools that have changed.

Neal French wrote on the challenges of technology to traditional craft and uses the example of the ceramics and table ware industry in his essay 'CADCAM and the British ceramics tableware industry'. He argues that the downside of computer aided drawing (CAD) and computer aided machining (CAM) is that this

has accelerated the design and modelling process to a point where the craftsperson does not have the time to carefully consider the finer details of each piece which then threatens the liveliness and tactility of the work (French 1995, p. 165). He concedes that CADCAM is here to stay in the crafts industry but sees the potential of 'running traditional and CADCAM workshops together allowing interaction of information between the two modelling methods' (French 1995, p. 166). He then continues by saying "...perhaps one needs to learn to think in three dimensions in the real world before one can get the best out of the computer's 'virtual' world." (French 1995, p. 166) Peter Dormer makes the point in support of French that the big difference between craft and CADCAM is that "in craft the relationship is between a person, a tool and a material. In CADCAM the relationship is only between the person and the tool." (Dormer 1995, p. 146)

John Makepeace the renowned furniture designer is an established craftsperson with a career spanning many decades. In regard to the implementation of digital technology with traditional craft techniques he holds that: "The value of an object is determined by the intimacy with the material, the process and the concept. This will not change, regardless of time and progress. Indeed, it will remain the cultural foundation of all crafts." John pointed out. Craftsmanship will remain the same regardless of technological advances, same as that technology does not pose a threat to a craft's cultural heritage," (Craftsmanship Soul 2019)

French's hope is that the creative potential of CADCAM will be better utilised by manufacturers as it is currently being used mostly as an efficiency tool resulting

in the creation of a stylistic monotony. The potential of this technology is that it should be used to create exiting shapes unattainable by the old methods (French 1995, p. 167). This supports my own view that this technology should be utilised to explore new possibilities, and foster innovation rather than simply to make the same work as was made before CADCAM, but at a faster pace and without the need for a deep understanding and tacit knowledge of materials. One issue that I have with CADCAM is that it takes away some of the enjoyment and sense of satisfaction that was formerly experienced when making a challenging project. At this stage I may be beginning to sound like a luddite pining after the good old days but one of my most stark memories of CADCAM was when I the craftsperson was relegated to standing next to the router holding a vacuum cleaner hose at the ready to clean up after the machine as it happily carved out a complex mould that I previously would have done myself. But this is a romantic notion that does not take into account the practical benefits of CADCAM. Some of these benefits include: an increased level of sustainability through less wastage of materials due to improved efficiency and less human error, enabling craftspeople to undertake more ambitious projects; greater accuracy and a greater level of safety as a separation between the worker and the machine is achieved which reduces hazards posed by cutting tools and dust exposure. The caveat to this is that the value of some crafts people's work lies in the fact that it is obviously and unashamedly handmade. Finger marks in pottery, gouge cuts in carvings or even a rough-hewn finish is what makes those works desirable. By trying to make the same works using CADCAM they would lose their magic, becoming artificial and contrived.

Conclusion

In summary, this project has its basis in my fascination with boats and my intrinsic connection to the aquatic environment. The boat is an ancient but still vital invention which has allowed people of varied cultures to interact with and utilize water by harnessing buoyancy. In order to interact with the element of water most successfully the boat takes on a streamlined form similar to those found in nature. The aesthetic beauty of the boats curvilinear form has been appreciated and noted in literature. Curvilinear forms can also be aesthetically pleasing in a broader sense as Nejad discovered in her study: *Curvilinearity in Architecture: emotional effect of curvilinear forms in interior design.* People were found to react positively to the curvilinear form partly because they reflect natural forms found in the environment leading to our habit to anthropomorphise the boat almost always giving them a feminine identity. Water takes its form in a variety of states and I have selected reflective water, deep water and powerful water as subjects of my investigation since, while they share similarities, they possess their own unique properties. A commitment to craftsmanship is an important element to my work, and I seek to integrate digital technology into my practice without significant compromise. The way in which furniture designers Joseph Walsh, Matthias Pleissnig and Wendell Castle integrate digital technology into their work is reflective of my own approach. Technology is utilised to the betterment of their craft practices by using it to create more ambitious and innovative projects. Their work still requires

traditional furniture making skills and tacit knowledge with a seamless synthesis of craft and the digital a hallmark of their practices. The work of these three will be discussed in detail in the next chapter where I provide a more in-depth review of their practices. The work of Constantin Brancusi will also be examined as the way in which he was able to distil a subject down to its essence while maintaining its meaning is of relevance to this project.

Chapter 2: Context

Introduction

The three key topics of my project: the boat; the element of water and technique have all been previously explored using varied mediums by artists and designers. The four artists and designers that I will be examining in this chapter are Joseph Walsh, Matthias Pleissnig, Wendell Castle and Constantin Brancusi. These artists and designers were selected because of the way they combine the analogue with the digital and/or their use of curvilinear forms inspired by the natural environment. All but Brancusi are more aligned with the field of design rather than that of sculpture, although, the line between sculpture and three-dimensional design can be opaque at times, particularly with the following examples. So, you may be asking at this point why am I using designers for context in a sculptural investigation? The answer lies in my background as a fine furniture designer and maker who received his training at an art school some years ago. For most of my career I have been creating highly finished and detailed pieces of furniture which exhibit sculptural qualities. For this project my desire has been to avoid the constraints that present themselves when creating functional objects to enable a deeper, more philosophical investigation of my practice. The notion of craftsmanship features strongly in my approach and is a key driver. It is demonstrated by the implementation of a variety of techniques from concept through to the finishing process.

The work of furniture designer Joseph Walsh is of interest as he creates a synthesis between traditional craft techniques and digital technology. His work takes its reference from natural forms, the hallmark of his practice being sculpted free flowing laminations. The focus of Matthias Pleissnig's practice is making curvaceous bench seats using steam bent timber strips. The inspiration for his unique construction technique is a variation on the ancient skin on frame boat building method. Like Joseph Walsh, Matthias Pleissnig utilises the power of digital technology to take a traditional technique to a higher level. Wendell Castle was one of the fore fathers of the designer maker movement. His career spanned many decades and for most of that time he carved monumental sculptural furniture in the traditional analogue way. However, Castle eagerly adopted CADCAM technology into his practice and utilised a robotic carving machine to rough out his works, enabling him to undertake more ambitious works. Constantin Brancusi, the renowned sculptor, had the ability to be able to distil a subject down to the most basic of forms while retaining its spirit and has influenced my minimalist approach.

Joseph Walsh

The Irish furniture designer Joseph Walsh is a subscriber to the notion of craftsmanship and resists the temptation to produce a greater volume of work more quickly that compromising one's craftsmanship can enable. A feature of his works is the high level of craftsmanship demonstrated, which is highly innovative in its execution, testing the boundaries of what is currently possible with timber. Walsh believes that the quality of our lives can be enhanced by objects that are

thoughtfully created with values beyond their function, which stimulate our senses when we are around them. (Walsh 2017)

Walsh creates sculptural works which feature sinuous flowing strips of timber which meld together into forms which reference the natural environment. His approach to the construction of his work and his method of construction is defined as strip lamination and involves slicing large rigid lengths of timber into thin flexible strips. He then stacks these strips back together applying glue between each layer. By slicing the timber into thin strips, it changes properties from rigid to flexible enabling Walsh to create solid timber members which are laminated into complex shapes. The way that he enables the timber strips to find their own natural form in the free-flowing laminations reflects this natural reference as opposed to standard lamination where the strips are formed around a man-made mould which dictates the final shape. His highly detailed works have a decidedly art nouveau style to them with their referencing of nature and decorative flourish. A key element of this decorative element is the connections between laminations where they are at a tangent to each other reminiscent of the fractal nature of trees and plants.

An example of Walsh's work is his *Enignum* dining table 2017. He describes how he laminates strips of timber into free form compositions enabling the material to find its own form which he says is a "collaboration of man and material" (Walsh 2017)

Fig. 5. Enignum Dining Table, Joseph Walsh, 2017.

Walsh is pushing the boundaries of furniture design and craft by devising new techniques adapted from established methods and in the way that he utilises the power of technology whilst still maintaining highly crafted work. I am also utilising a method of lamination, that being cold moulding. However, while Walsh seeks to create structures which are composed of a series of interconnected ribbon like members, I am exploring the creation of forms which are composed of shell like monocoque structures which express the form in a more minimal way.

A designer whose work is more streamlined and less adorned than Walsh's is Matthias Pleissnig who is the subject of the following section.

Matthias Pliessnig

Matthias Pliessnig is an American furniture designer and maker. Pliessnig's focus is on creating curvaceous bench seats by steam bending a series of thin timber strips and fixing them to a supporting framework of ribs which form the outline the shape of the piece. He was inspired to begin making these works after building a small boat for himself. The flowing undulating forms of his seats appear to reflect the swell of the ocean where each individual swell has its own unique form linked together by the gently curving troughs in between. The gaps between each strip create a series of linear lines which give definition and accentuate the undulating curvaceous shape of the form with the edge of each strip catching the light and creating shadow. Indeed, his works are reminiscent of a three-dimensional computer model where a grid is used as a visual aid to help the user perceive the shape of parts on the screen.

An appeal of Pleissnig's practice is that he has developed a unique method of construction from a traditional boatbuilding method, successfully adapting it to furniture. The method that he has adapted is an ancient technique known as skin on frame construction and has been utilised by the peoples of Asia, Europe and North America since the first millennium BC. (Hornell, p. 91) In this technique a lightweight framework consisting of ribs which form the outline of the craft are connected by battens which run lengthways along the hull. An animal skin or some other water-resistant fabric is then stretched over the frame forming the hull. The small gaps left between each of the strips eliminates the time-

consuming task of having to taper each piece to fit together seamlessly which is necessary in a solid wood boat to enable it to be watertight. For Pliessnig, these gaps provide an aesthetic detail and reduce the amount of materials used. For the peoples who utilised this technique for their boats and kayaks it was of necessity as timber was not widely available in their area. Pliessnig's measured approach to utilising technology in the design process and this harmonisation of wood craft and digital technology is a critical element.

Fig. 6: Amanda Bench Seat, Matthias Pliessnig, 2010.

The notion of the harmonisation of traditional craft techniques and materials with digital technology is a key to the narrative of this research. Wendell Castle is one designer maker who was able to create a synthesis between the analogue and digital.

Wendell Castle

Wendell Castle was an American designer and maker who created sculptures and furniture over many decades. He is a particularly interesting example to study in relation to the harmonisation of craft and technology as he was a practicing artist and craftsperson spanning the last sixty years. During his career he was present when digital technology first began to be developed and he has managed to evolve through this rapidly changing period from having a practice that was totally analogue in nature to one that has carefully considered and implemented technological developments for the betterment of his art.

Key features of his work were his use of large organic wood forms and the surface finish where gouge and other tool marks were often left untouched adding an element of tactility. For the most part of his career, he made his works in the traditional manner of the designer maker, hand making scale models out of materials such as wood and foam before constructing the final work. In Castle's case this meant stacking up and gluing a large number of small wooden blocks together to generate the rough shape of the intended work. This method is called brick lay lamination and as its name implies applies the same principles as bricklaying using earthen bricks. There are similarities between this form of lamination and cold moulding in that timber is cut into small dimension pieces and then many pieces are assembled into larger structures. The intent of both techniques is to minimise the natural expansion and contraction of timber which increases in line with the size of the timber sections. Castle would then proceed

to laboriously carve and finish his works with hand tools such as gouges with the cut marks often left visible.

In recent years, Castle incorporated contemporary digital design and fabrication technology into his practice to aid in efficiency and to enable him to realise more ambitious projects. His traditional approach did not change greatly, and his works were still highly crafted. However, in recent times he utilised a 3D scanner to scan his models which could then be transferred to a computer aided design program (CAD) to enable them to be scaled up to their full size. The full-sized computer model could then be sliced into separate parts enabling plans and templates to be generated to minimise the requirement of laboriously fitting each wooden block piece by piece by hand. A robotic carving machine, much like what is used in large factories for car manufacturing, was then employed to rough out the desired form. At the same time however, his works were still painstakingly finished by hand, retaining the tactility and human connection.

Castle's approach has embraced technology and its benefit's and he has been able to avoid compromising his artistic integrity by maintaining the connection between the head and the hand as argued by Richard Sennett in his book *The Craftsman.* (Sennett 2008, p. 52) As we as move into a time where the digital is becoming more and more entrenched in every facet of our practices from concept to completion there are benefits to be had by looking closely at artists

such as Wendell Castle who possessed what is becoming an increasingly rare knowledge of both the analogue and digital.

Fig. 7. Phantom Rocker, Wendell Castle, 2009.

Constantin Brancusi

Constantin Brancusi, the well-known sculptor of last century, created a series of works exploring the curvilinear forms of animals. Of most interest to me is his sculpture named *Fish* created in 1930 in which he captures the pure essence of the creature by removing all superfluous details such as the eyes and fins leaving only the streamlined form of the body.

Fig. 8. Fish, Constantin Brancusi, 1930.

> *"When you see a fish,"* said Brancusi *" you do not think of its scales, do you? You think of its speed, its floating, flashing body seen through the water...Well I've tried to express just that. If I made fins and eyes and scales, I would arrest its movement and hold you by a pattern or a shape of reality. I want just the flash of its spirit."* (Bush 1975, p. 11)

Brancusi captured the abstract nature of creatures in a literal sense by taking a physical being such as a fish and stripping its form right back to its archetypal and elemental form. It is this notion of reduction which has informed my own work.

I am also interested in the way that he managed to capture the movement of his subjects as if they are frozen in time in his static sculptures which are mostly

constructed of solid, dense unyielding materials such as stone. The asymmetric elliptical shape of *Fish*, 1930, creates a sense of lift in the work making it appear to float (Baciu 2011, p28) as a fish would in the ocean and the highly polished stone surface provides an appearance of liquidity. The ability of Brancusi to create a sense of movement in a static sculpture is of importance to my project as I am intending to capture the essence of the infinitely moving oceanic water.

How Brancusi suspended or supported his works which are very dynamic forms is an inseparable part of his works. In furniture this is not such a concern as the work by its very nature of functionality dictates that it requires a structure that is grounded or supported in some way to enable use. However, with dynamic sculptural forms the plinth must support the form while either being an integral part of the form or in a way become a secondary element and fade into the background performing its task without interfering with the main focus.

Conclusion

Through the analysis of the previous artists and designers with the exception of Brancusi, I have sought to demonstrate the value in integrating digital technology into an analogue practice. The designers discussed have all been able to undertake works which are more complex and ambitious without compromising craftsmanship. Taking reference from elements of the natural environment is a focus of all the discussed artists. This connection with the environment humanises their work encouraging interaction. Matthias Pleissnig's adaptation

of an ancient boat building method coupled with CAD has uncovered new possibilities in terms of technique and aesthetics in the field of wood working. Wendell Castle was able to incorporate CADCAM into his practice while maintaining elements of the handmade demonstrating that a strong connection between the maker and their work can still be maintained and not compromised in modern times. Joseph Walsh has taken the strip lamination method to a new level by also utilising CAD to assist in resolving the complex geometry of his works. The forms that he creates are reminiscent of the fractal nature of plants and trees where branches are joined at a tangent to one another and this similarity is made more apparent in the way that he lets the material bend to its own shape to some degree. By paring his sculptures back to their archetypal forms and removing the superfluous and distracting elements Brancusi was able to reveal more about the spirit of his subjects in his work than if they were exact detailed reproductions.

In the next chapter I will discuss the methodology behind my works beginning with the design process which will detail the methods used to develop and resolve the forms. The historical background and development of the cold moulding method and how I have adapted it to my own works will be covered in the technique section. The materials I selected and a description of the practical and aesthetic rationale behind their selection will be discussed. Two prototypes were created to validate my theoretical research into the cold moulding technique, the findings of this research will be discussed. The notion of the

archetype and how it is relevant to this project will be covered along with the iterative nature of the works. A discussion of each of the works and the theoretical foundation behind each will conclude the chapter.

Chapter 3: Methodology

Introduction

The project has been undertaken in three phases. These are: theoretical research; practical research and studio practice. For the first phase – the theoretical research – I have researched sources of literature to better understand the wider significance and importance of the boat including construction techniques and the element of water. As a part of this process I have explored my own personal connection to both and the inspiration that they have had on my practice. The practical research has involved researching, testing and adapting the cold molding construction process. For this I consulted technical publications to gain an understanding of the principles behind the technique. The testing phase of the practical research involved making two prototype forms so as to gain a hands-on knowledge of the process. The process was adapted by scaling down the size. The final phase was the studio practice where I completed three sculptural works in response to the theoretical and practical research, demonstrating the relationship between the boat and the element of water using an adapted version of the cold moulding boat building technique which included the integration of digital technology.

This chapter will begin by discussing the design process for the final works beginning with the initial research that formed the basis of the project through to the actual design methods employed. Following, an overview of the techniques employed to make the works and the reasons behind their selection

will be discussed. Integral to the techniques employed are the materials used which will be discussed. From this theoretical research two prototypes were created to test the validity of using the cold moulded technique for smaller scale works and both analogue and digital fabrication methods were tested. The results of this research and prototyping and their potential will be considered which then leads to a focused examination of the three works explaining the aesthetic and construction details and how the theoretical underpinning influenced the final works.

Archetype

During my research into the boat I was drawn away from my initial interest in the aesthetic beauty of yachts which has inspired previous work, becoming captivated by the historical and cultural significance of the boat. I realised that all boats that have ever been built share a similarity in that they are vessel forms which led me to the archetypal boat form. The link between the boat and water is an obvious one which I have explored in this project melding what are linked but separate elements into one.

An archetype is a generally held idea of what someone or something is or looks like. (Collins Dictionary 2019) Jung argued that archetypes are already within us as a collective unconscious inherited from previous generations (Jung, p.3-4). My boat form is what I see as a representation of a boat, in its most simple form, so

by repeating this same form throughout each work it reflects more powerfully the notion of the importance of the boat. If I were to create three works derived from three different boat shapes, I feel that this would weaken the idea of the archetype and therefore less clearly communicate the narrative of my work by taking the focus away. A boat is more broadly a type of vessel, which is made to hold an item in the same way that any other vessel functions such as a bowl. When I made my first prototype which is small and can be held easily in one hand, a number of people initially thought it was a bowl before I explained its real purpose. A peer also commented the larger prototype was reminiscent of the baskets that indigenous tribes used for carrying a multitude of items. This assumption by people that my boat form was actually a vessel for holding items reveals the vulnerability of the boat. The vulnerability and strength is the property of watertightness vital to remaining buoyant and keeping its contents secure. This property can also become a liability as a boat is able to hold water in its hull as equally well as keep it out. The archetypal boat form is constantly walking a fine line between positive buoyancy and negative buoyancy with disaster never far away. As soon as water is able to find its way into the vessel whether through a leak in the hull or waves which are able to break over its sides to the point of it filling with water it is easily overwhelmed.

Technique

The main area from where I have sought knowledge regarding constructing curvaceous forms is from the field of wooden boat building. While other materials such as metal and fibreglass are also suitable mediums for creating these forms, it is wood that is the main focus of my practice with which I have the most experience and so is the material of choice for this inquiry. In order for a boat to perform efficiently it needs to travel through water with a minimum of force. This is achieved by creating curvaceous, streamlined hydrodynamic hulls, which, while being entirely pragmatic in their design, are at the same time aesthetically pleasing forms.

The cold moulding construction technique that I have used for my works is a variation of a technique developed during World War two to construct Mosquito Aircraft, torpedo boats and other small craft. Below is an image of a Mosquito aircraft fuselage being manufactured in Australia during World War Two. (Fig. 10.)

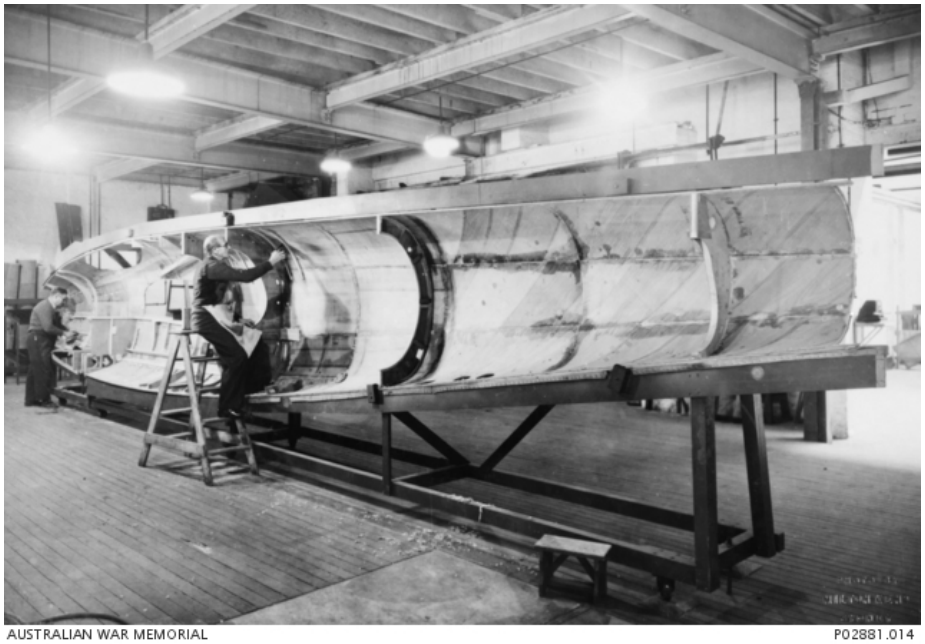

Fig. 9. Milton, K, Mosquito Aircraft Fuselage, c.1943.

A historical overview of the development is given by Meade Gougeon in his book *The Gougeon Brothers on Boat Construction 2005.* He states that laminated hulls were originally moulded hot in autoclaves, which are large pressurised ovens, as the glue at that time required heat and pressure in order to cure. This technique was developed significantly during World War Two, as metal was a scarce commodity. This rapid development led to the invention in the 1950's of adhesives which cured at room temperature without the application of pressure, negating the requirement of expensive autoclaves and making the technique more available. (Gougeon 2005)

The process of cold moulding is described by naval architect Ian Nicholson in his book *Cold Moulded and Strip Planked Wood Boatbuilding 1983,* as a technique of

gluing multiple thin layers of wood together into a composite material. He notes that it differs from traditional boatbuilding where separate pieces are fixed together so that each has a degree of movement. (Nicholson 1983, p. 10) Accounting for movement is necessary in a traditionally built boat as large pieces of timber are used in their construction and timber naturally expands and contracts in response to the environmental conditions. When immersed in water it expands and when left to dry it shrinks. Cold moulding minimises the issue of timber expansion and contraction by using a series of small section pieces of timber, as a small piece of timber moves a small amount while a large piece can move a great deal.

As the cold moulding process was created with the intention of building the hulls of boats and the fuselages of aircraft, I have been required to adapt this technique from its standard form as previously described to be suitable for use in the smaller scale forms that I have created.

Material

I have selected timber veneer as the primary medium for all the works. Timber veneer is a familiar material to me as I have worked with it frequently. Wood is a natural material that exudes warmth and character and it possesses a high level of tactility which draws the viewer in, encouraging them to touch and physically interact with the work. As the works are quite complex in their shape, I have used a timber which has a subtle grain pattern and uniform colour so as not to distract from the overall aims of the work. Timber is a finite resource and it is important to use it as efficiently as possible to minimise pressure on this valuable material. The cold moulding method I am employing is a highly efficient way to use timber as a small amount is used to create a rigid self-supporting structure. The way that veneer is processed is an efficient way to process timber in itself. Timber which is processed in its solid form is roughly cut on a saw which results in a degree of wastage and then after drying machined to the final dimensions which results in more wastage. Veneer is processed by soaking a log in hot water until it softens. The log is then sliced or peeled into thin layers resulting in a much higher recovery than when sawn.

Timber is the preeminent boat building material if the whole history of boat building is taken into account. It is only in recent times that modern materials such as metal and synthetic composites have become more common as they are more suited to mass production methods or are more efficient to fabricate.

Cold moulding relies on adhesives to hold the layers of veneer in position. The adhesive I am using for these works is PVA glue which is very user friendly in that it is easy to apply is non-toxic and is easy to clean up as it is a water-based product. Being nontoxic is important to me both for environmental reasons and also for my own health. Being a maker for several years now, I have become particularly aware of the potential health risks posed by using toxic materials. This leads to my choice of French polish as the finish for the forms in this investigation as it is low in toxicity in comparison to many other solvent based finishes. The other appeal of French polish is the way in which it accentuates the depth in the grain of the timber acting like a magnifying glass so that all the subtleties of the wood are brought out. It is applied in many thin layers using a rubber which is a piece of wadding wrapped in a piece of soft cotton. By rubbing the finish into the surface by hand it is pushed into the pores of the wood rather than with a synthetic finish which forms a coating on the surface which provides a more durable finish but at the expense of clarity.

The First Prototype

The first form I created was small in scale approximately 500mm in length and 150mm in width. I selected Golden Sassafras as the species of veneer for this work because of its workability in veneer form more so than its appearance although it is an attractive species of timber with an even light-yellow colour and subtle grain. It is a pleasant veneer to work with as it is soft enough to cut easily but not so soft that it is spongy and difficult to achieve accurate results with. It has a tight grain and even density with minimal brittleness which enables

accurate work with hand tools, and its light colour means markings can be more easily worked to. It also exhibits a good degree of flexibility which is of great importance when creating curvaceous forms.

The method of construction for my first prototype proceeded as follows. This work began with the making of a male mould using the CNC router to carve it from a block of plywood. This mould was then refined by filing and hand sanding, fairing it to its final shape. Following is an image of the completed mould. (Fig. 10.)

Fig. 10. Randall, N, Mould, 2019.

With the mould constructed I then proceeded to begin laying the pieces of veneer over the mould, temporarily fixing them in place to form the first layer of a subsequent three layers. These pieces were laid in what is known as a herringbone pattern where each piece is aligned at an approximately 45-degree angle from the centre of the form. The following image shows the layers of veneer being applied to the mould.

Fig. 11. Randall, N, Prototype 1, 2018.

This was the most difficult part of the entire process as each piece of veneer had to be scribed and shaped to fit using a hand plane, checked and if necessary, shaped some more until a tight joint was achieved with each piece being unique. Scribing in relation to wood trades is tracing the outline of one piece of material onto another so that they fit together accurately. The reason for this is that because the boat is a compound form, the distance from each end across the centre is different from the distance from both ends around the edge which

means each piece needs to be tapered to accommodate this difference. A good example of this is in wine barrels where each of the staves is widest at its centre and then tapered to each end to make up for the change in girth.

Once this first layer had been fitted, I proceeded to lay the second layer in much the same way as previously described with the only difference being that it was laid with the herringbone pattern angling the other way to the first, creating a cross hatch effect between the layers of veneer. This is a crucial element to the success of this technique as the strengths of timber are maximised while its weaknesses are minimised. This is because wood is strongest along the grain and weakest across it, the reason being that wood is in effect a series of tubes which run the length of the tree. The bond between these tubes is weaker than the structure of the tubes themselves. By layering the veneer with the layers at opposing angles to each other the weakness of the grain is minimised. This second layer was then bonded to the first with PVA glue. PVA glue was chosen in this situation as it creates a strong bond, is fast to cure and as it is non-toxic is more pleasant to use than most other alternatives. A vacuum press was used to provide an even clamping pressure to the layers of veneer while the glue cured. The following image shows the vacuum pressing process. (Fig. 12.)

Fig. 12. Randall, N, Vacuum Pressing, 2018.

The third and final layer was fitted in the same way as has been previously described for the first layer. The finished piece was then faired by hand using variously shaped sanding blocks as the curved shape prohibited the use of any form of powered sander. Once sanded, a coat of epoxy was applied to both sides of the work to test if it provided significant additional rigidity since, while the form held its shape well, it was a bit flimsy. The coating of epoxy did provide an increased level of rigidity to the form but was unnecessary in the subsequent prototype and final works as more layers of veneer were used to provide the required rigidity rather than epoxy. The method as described above is in essence a scaled down version of the established boat building method of cold moulding. On the following page is an image of the first prototype in its finished state. (Fig.11.)

Fig. 13. Randall, N, Prototype 1, 2017.

The Second Prototype

The second form that I made was larger in scale being 1000mm in length and 280mm in width. The mould was constructed in the same way as the smaller mould described previously by using the CNC router to carve the shape. As this mould was too large for the router to cut in one piece it was first carved in two pieces and then joined together into the final shape.

For this prototype my aim was to explore the potential of utilising digital design and fabrication techniques to assist in calculating the shape of each piece of veneer in relation to the mould which then enabled me to laser cut each part rather than having to laboriously hand shape each. The benefit of this approach was it enabled me to cut all my pieces from one larger sheet of veneer rather than a whole lot of individual pieces as before. As well as simplifying the construction process by using one larger sheet of veneer I was able to retain the

continuity of the grain pattern and in a way tailor the flat sheet of veneer over the mould providing an interesting aesthetic detail. The following image shows the sheet of veneer after it has been laser cut and before it has been formed around the mould.

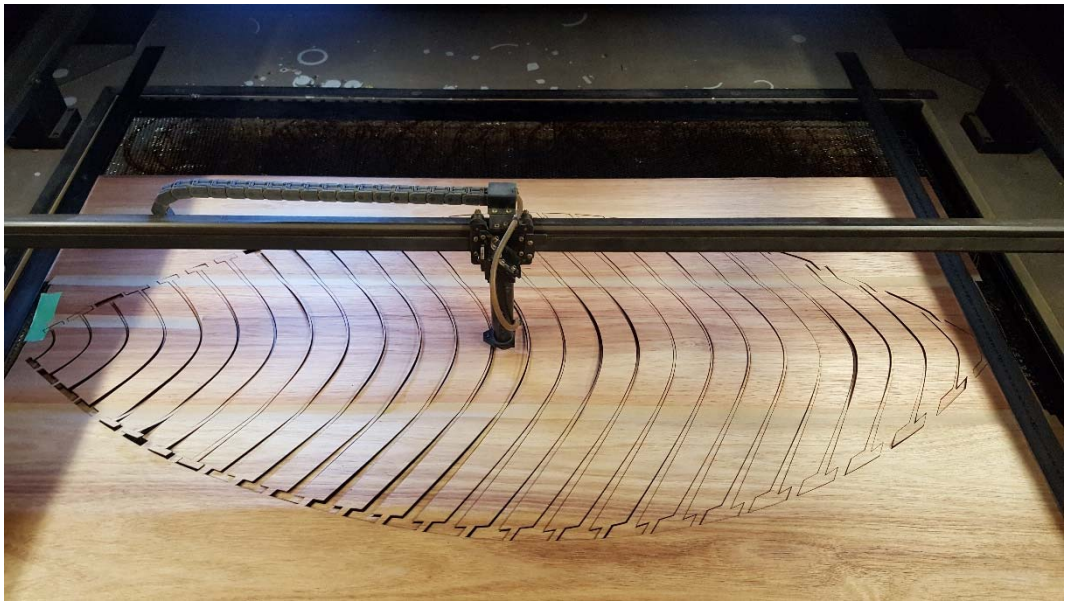

Fig. 14. Randall, N, Laser Cutting, 2018.

Once this first layer was attached temporarily to the mould with masking tape I then glued the second layer to the first using PVA glue and a vacuum press for the clamping pressure. Rather than lay the veneer at a 45% bias as previously stated and which is the traditional method, I experimented with laying the second layer at a 90% bias. This was straightforward in that I was able to manipulate the grain direction in the laser cut parts easily by cutting the pattern length ways along the direction of the grain or across the direction of the grain. I then laid three more internal layers followed by a final layer to form the exterior. By having seven layers, the strength and rigidity of the form was increased greatly. The fairness of the form was also able to be retained unlike my first prototype with three layers which had a slight degree of deformation which was

enough to be visible to the naked eye. With the final layer, I experimented with cutting the veneer in a lengthways fashion in the style that you would employ with the planks on a traditional wooden boat. On the following page is an image (Fig.12.) of the second prototype in its finished state.

Fig. 15. Randall, N, Prototype 2, 2018.

The results from my tests into moulding timber veneer into compound curved forms were favourable and demonstrated that my idea of utilising this technique for sculptural forms was a viable one. Through the construction of these two prototypes, I was able to test the malleability of natural material such as timber, determining how far it could be bent and manipulated by hand as well as devising a method to incorporate digital fabrication techniques into what is still to a large extent (moulds excluded) a manual technique. This was successful, enabling me to explore the creation of more complex and expressive forms while at the same time simplifying the construction process.

Reflection

The first of my final works responds to calm, reflective water. For this work I intend for the viewer's attention to be drawn into the glassy surface of the form, the magnifying effect of the polished surface capturing their gaze much in the same way that a beautiful calm waterway does. In the first chapter the potential for reflective surfaces to have a mesmerising effect was explored namely through the practice of scrying where people enter a trance like state by focussing on a reflective surface such as water. French polish was selected to finish this work as it is the best choice in bringing the depth of the timber out by highlighting the grain patterns of the wood. Seldom used these days because of its time-consuming application and delicate nature, some forty coats of French polish were applied by hand in able to achieve a smooth surface with a high level of reflectivity. This references calm water's ability to reflect light while at the same time having a translucency and depth. The upper side of the work has a dark Blackwood veneer while the underside is finished with Huon pine. Blackwood was selected for the upper side as it is evoking the experience of looking down through the surface of a body of water into the dark depths. The tonal variabilities of the Blackwood I selected ranges from a light yellow to dark brown with the light figuring referencing the way that the light plays on the shimmering water. Huon Pine is a lightly coloured timber which, when finished with French Polish, catches the light and shimmers beautifully in the same way that when you are under the surface of the water looking upwards, the surface is a bright, shimmering expanse. This observation comes from my own personal

experience diving where often the seafloor is not visible for some time when descending but when I am ascending the surface is brightly lit. Rolling over and gazing at the shimmering underside of the surface of the water is I find a most pleasurable experience. Some pelagic fish such as Tuna which live in the upper levels of the ocean have adapted to this environment by being darkly coloured on the top side of their body and silver on their underside which helps them to hide from predators. The form is suspended on a thin black wire frame which cradles it in a horizontal position so that both sides are easily accessible to the viewer. The horizontal positioning represents the flat nature of the surface of calm reflective water. When viewed from above the darker blackwood veneer dominates the view while when the underside of the sculpture is viewed the Huon Pine is the feature in reference to the nature of reflective water as previously discussed. The form is positioned approximately 1000mm from the floor to enable the viewer to look closely at the work without discomfort. The intent of the thin wire frame is to float the work in space and be a minimal distraction to the form. The ocean is a vast expanse with the surface layer being in a way the gateway to this environment. In the next section we will descend into the abyss with my next work 'Depth'.

Fig. 16. Osborne, M, Reflection, 2019.

Depth

The second work responds to deep water seeking representing the way in which deep dark water is able to absorb and consume matter. A dark, almost black stain has been applied to represent the deep twilight zone in deep waters where the last rays of light are just able to penetrate. The stain enables the timber to be coloured while still having the transparency for the texture of the natural grain to show through. Each join between the external layers of veneer has had a vee shaped groove carved into it with a specially made hand tool. The purpose of this is to accentuate the shape of the darkly finished form as the assistance that light and shadow usually provide to help visualise and interpret shapes are minimised because of the dark finish concealing the play of light and shadow. Again, French polish is used to finish this work but with less coats which provides a lower level

of gloss and enables the texture of the timber to be retained by not filling the grain completely. One of the properties of Sassafras is its fine grain, which is subtle, so as not to detract from and complicate the form. This work is positioned vertically and is held in position by a thin wire frame. The vertical position of the twisting form is inspired by whirlpools as a representation of the way water moves in a constant swirling motion. A vertical positioning also seeks to accentuate the notion of deep water as the form is positioned standing up at its full height at eye level of the majority of people.

The intent of this work is to evoke a sense of the ephemeral nature of deep water where flora and fauna are constantly on the verge of appearing from or disappearing into the abyssal darkness.

An interesting juxtaposition between the machine made and the hand-made presents itself in this work. All the parts are laser cut, making each joint even and fair. By using a hand tool to carefully carve a groove into these joints small irregularities appear which I believe maintains the connection between the maker and the work. In the period of digital transformation in which we currently find ourselves where digital technology enables us to produce works with less aesthetic flaws, it needs to be considered whether this is in fact desirable. These days I delight in viewing a work which, while beautifully crafted, unashamedly and deliberately provides glimpses of the hand of the maker in the fabric of its being.

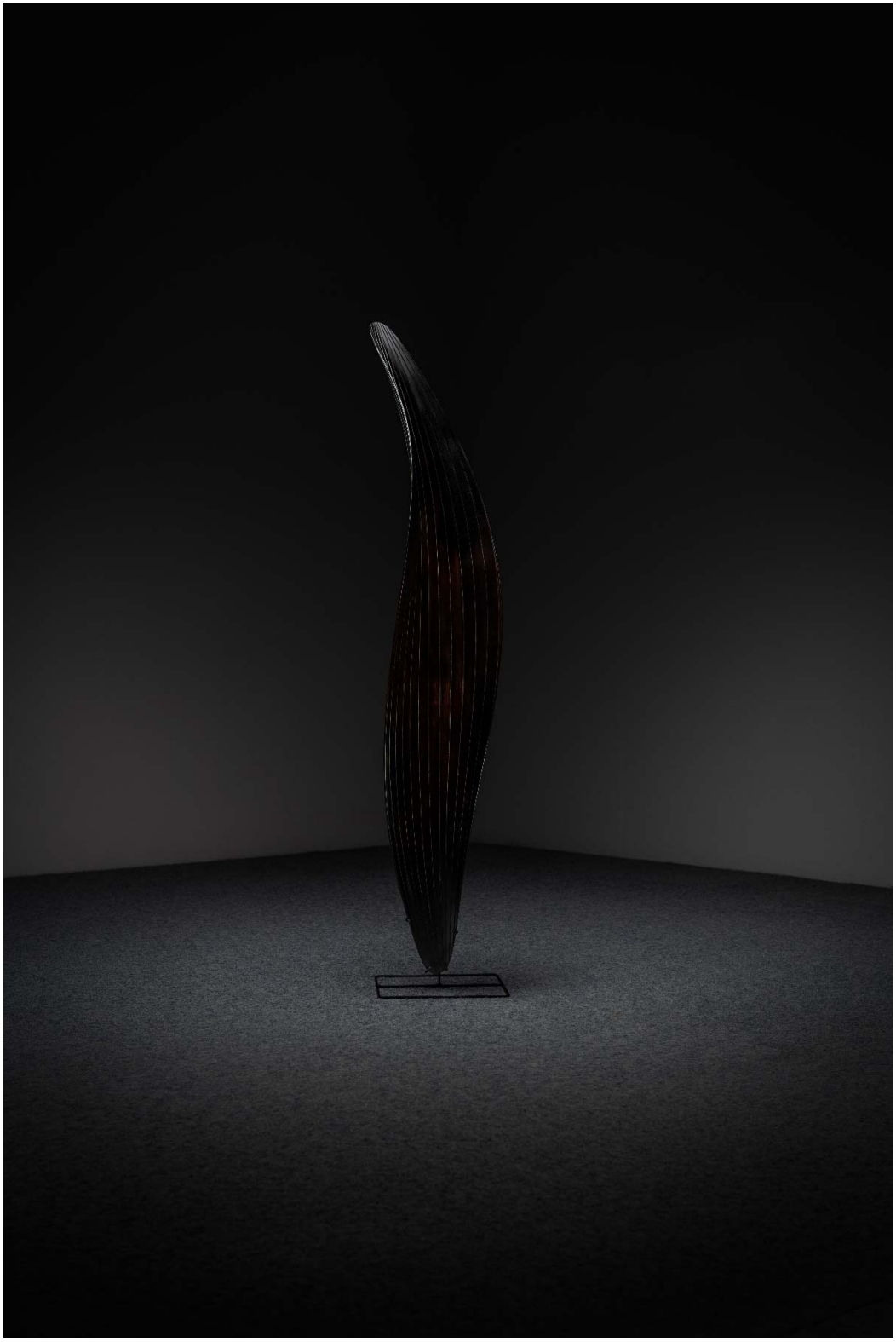

Fig. 17. Osborne, M, Depth, 2019.

Power

The third work responds to the power of water. Boats and their human creators are incredibly vulnerable to the strength of water. It can overpower anything we build to contain or control it. What is a unified shell-like form in the two previously mentioned works is broken apart into a series of rib-like pieces reminiscent of a carcase which has been eroded by the natural environment with just the skeleton remaining. Boats are constructed like the body of a human with the ribs and framework providing the skeletal structure, and the planking acting as a membrane separating the interior contents from the environment in the same way that skin does. The breaking apart of the form into a series of individual ribs references the monumental power of water and its sheer destructive force. Each rib has been tapered at each end, slicing through the layers and exposing the laminated nature of the construction method. The purpose of this was to reference a far less dramatic form of waters power which is the way in which it is able to slowly erode away the most robust of materials. A notable difference with this work compared to the other two is that the cold moulding method gains its strength by all the parts being permanently connected into one monocoque structure where each part relies on all the others for its integrity. By breaking the form into pieces, the structural integrity of the form is compromised. For a boat or indeed a piece of furniture its structural integrity is paramount to its success. In this instance I am making a sculptural form so the necessity for structural integrity is greatly reduced to the point of only having to support its own weight and retain the desired form. The way that I made this work I see is a hybrid of cold moulding as has already been

discussed in detail and strip lamination which is when straight strips of timber are bent and glued around a mould in one dimension as opposed to cold moulding where the one is working in three dimensions. This work was made by forming all the ribs in one glue up over the same mould as used in the other works rather than laminating each rib one at a time as is the usual way with strip lamination. Each rib is a unique shape and to hold each of the ribs in position I have moulded a backbone from wood veneer which follows twisting curves of the form. Each rib is secured to the backbone with glue and a small trenail, which is a round wooden nail which is tapered. A corresponding tapered hole is drilled for the trenail to fit into. The tapering makes the trenail act in the same way that a wedge does by locking itself permanently in place. Treenail's have been widely used in traditional wooden boat building and to a lesser extent furniture as a way to fasten planking to the internal framework. Although their use in boats was not a consideration when I settled on this method it is an interesting coincidence which reinforces the benefit of different crafts finding inspiration in how craftspeople of other disciplines resolve similar problems.

The plinth for this work is consistent with the other works, being a minimal slender steel frame finished with a black lacquer which floats the sculpture up of the floor in a cradle-like manner but does not distract the viewer's attention away from the sculptural form. The orientation of the form is horizontal and it is held by its cradle at a height of approximately 500mm. The purpose of this horizonal orientation and height is to make the form appear prostrate in its

manner with the intent of evoking a sense of capitulation of the form to the power of the element of water.

Fig. 18. Osborne, M, 2019.

Conclusion

Through the design process I have utilized digital technology to communicate my ideas and to assist with the fabrication of the works. The notion of the archetype was examined which revealed its power in communicating an idea by concisely expressing its essence. Technique forms an important part of this investigation as one of the key intentions was to develop an adapted version of the cold moulding method which was achieved successfully.

The works are displayed in the smaller separate section of the Plimsoll Gallery. This area is a more intimate enclosed space compared to the rest of the gallery and I think its scale fits my project well with the three works fitting in the space

but with room to spare. In terms of placement the three sculptures are placed in towards the center of the gallery to maintain a sense of connection between each, reinforcing the iterative nature of the works but with enough space left in-between so that the viewer is able to move around each piece and have enough distance from them to enable a full view from all perspectives. Because of the three-dimensional nature of the works, lighting is an important element of the installation and the smaller space suits this consideration better as it enables the lighting to be controlled. The space is mostly dark with each piece individually spot lit with just enough light to accentuate the shape of the forms and to highlight the surface finishes and detailing. The light is deliberately focused on each piece to enable them to be separated by the dark light. The minimal usage of light enables each piece to appear as if it is floating as the slender black supporting frames fade into the background. By not fully lighting each piece the extremities begin to fade away into the darkness again to evoke a sense of the forms floating in the ocean.

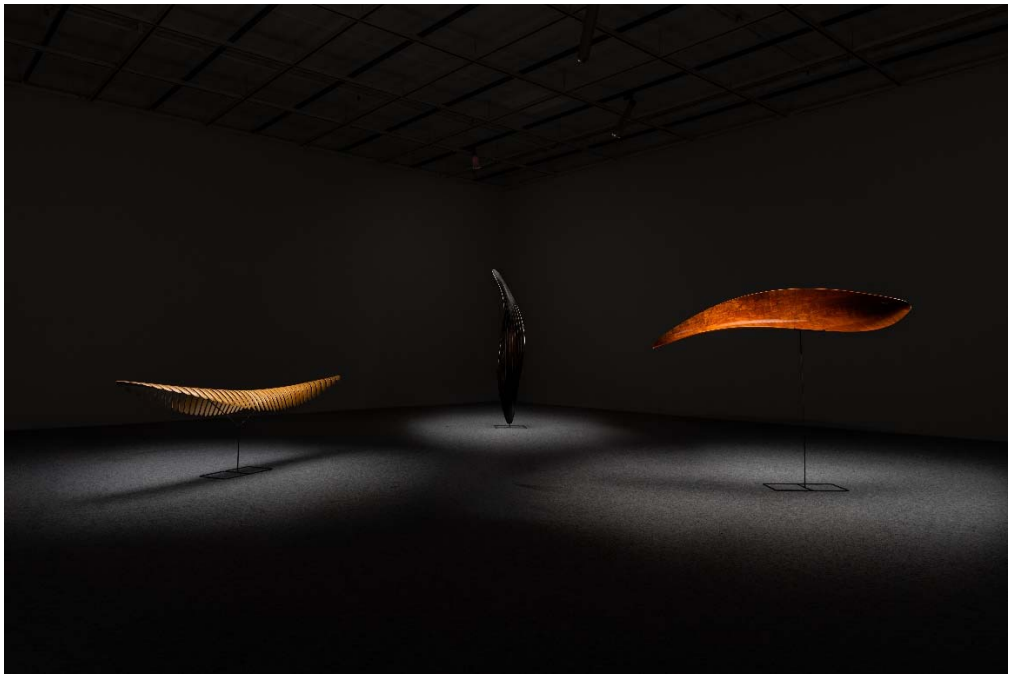

Fig. 19. Osborne, M, Fluidity Of Form, 2019.

Conclusion

The works produced in this project are the culmination of a long journey which began in my childhood where my interest in boats and the marine environment was nurtured. It has been a pleasure to be able to undertake a deep exploration of this passion and to express this in sculptural forms using another passion which is making. Through researching the cultural and historical significance of the boat I have found that it has been an intrinsic part of our lives since the most rudimentary of craft were invented. The boat is an ancient invention that is still in the present day a valuable tool to our society. And although modern day craft are far more sophisticated than their ancestors, the principle of buoyancy underlying all boats remains the same. Boats have been appreciated by sailors, writers and artists among others for the aesthetic beauty of their curvaceous hulls which are reminiscent of forms found in nature due to the need for them to interact directly and work in synthesis with the element of water.

There is an inextricable link between the boat and the element of water. I have used the boat as a visual metaphor to communicate our connection to the element of water and to show its inherent dynamism, focusing on reflective water, deep water and powerful water to highlight the extremely varied nature of water in its liquid form. Water and its importance to everyday life, fades into the background of our busy modern lives where more trivial matters are seemingly more important. This disconnection between us in the modern world and the elements which make up our environment is of concern to me as the more we become separated, the less we seem to respect and acknowledge that it is the elements such as water which are the basis of sustaining us physically and emotionally. The boat enables us to connect with water and to appreciate its beauty and tranquillity up close, but when on a boat, our vulnerability to the power of water and the other elements is revealed as we are at the ocean's mercy, no matter how ingeniously designed the boat we are on is. The intent of my sculptures is to pare the boat back to its most simple form enabling the exploration of its very essence and to reveal the significance of what is to many a taken for granted utilitarian tool. Water is an essential but also under appreciated element and by using the boat form I have been able to communicate the complexity and varied nature of water in sculptural form, the surface textures and finishes communicating the visual elements of water and the twisting of the boat form, its invisible swirling currents.

In developing these sculptural forms, I have demonstrated how digital techniques can be integrated with analogue processes, not just to improve efficiency and minimise cost, but to extend creative practice in ways not possible in purely hand-made production. When I commenced my career as a furniture designer and maker some years ago now CADCAM was only just becoming available to craftspeople like myself in Tasmania. This meant that at this time I was taught and then subsequently produced my work almost solely using analogue techniques. Over time I gradually incorporated more CADCAM into my work as it became more widely available but only to perform processes that I previously did by hand as it is for the most part faster and more economical as tools such as jigs do not have to be constructed. I came to a point where I realised that rather than using this technology simply as an efficiency tool producing the same sort of work as I did previously, I should find ways to utilise its power to improve on my previous work and to explore better ways of designing and making. Incorporating CADCAM into my practice has been transformative to the work I produce. However, I am very grateful to have been trained in more traditional methods where there is an intimate connection between the maker and the material, the benefit of which is a tacit knowledge of the materials and how they behave when worked which is somewhat lost in these days of hands-off manufacturing.

By continuing my exploration of synthesising analogue and digital techniques I have been able to develop an adaptation of the cold moulding method. Manual

methods can still be used to produce forms using this adapted cold moulding method as I demonstrated with my first small prototype, but to produce more complex forms requires the power of CAD to make the process viable by breaking the form down into its individual pieces and flattening them out so that the wildly different shaped parts can be cut out from the thin, delicate material.

CADCAM has been available for some time and is now widely utilised by makers both large and small. While it is a good way to create a more sustainable practice through minimising wastage of materials and reducing labour costs, I feel that more focus should be placed on using it to improve on existing techniques, fostering a more innovative sector, which in turn would deliver more creative potential to practitioners.

My contextual references Joseph Walsh, Matthias Pleissnig and Wendell Castle have all demonstrated that by incorporating digital technology into traditional designer maker practices, more ambitious and exploratory works can be undertaken without compromising the human connection that traditional craftsmanship enables. All have taken what were established and relatively unchanged techniques and adapted them to suit their purposes. Constantin Brancusi is of relevance to this project because of the way in which he created sculptural forms which revealed the soul of his subjects through paring them back to their archetypal form.

Creating shell like curvaceous forms in wood or compound curving has traditionally been a difficult task. This is due to the nature of wood only bending in one direction at one time. Because boats needed to be compound curved in shape to be their most efficient, boat builders devised ways to make hulls from many small pieces to obtain these shapes. By borrowing from boat building techniques, I have been able to adapt and scale down the cold moulding method to be suitable for smaller items such as sculpture and furniture. I have taken an industrial technique and adapted it into a process that is able to make bespoken and unique forms. By incorporating CADCAM into this process it has made the method more viable still. My desire is that other practitioners will be able to see by using the power of CADCAM thoughtfully, viable ways of introducing more innovative forms into their work are possible, and that by exploring the techniques of other disciplines there are rich pools of inspiration to be discovered.

As a result of this project the next step for my own practice is to continue exploring the boat and the element of water with a deeper focus on the narrative of the works than I have done previously, which was concerned more with aesthetics. I am excited to be able to merge what I have created for this project, which is a more artistic and expressive sculptural body of work, with the pragmatic design background from which I have come. As a result of this research I have had an idea for a sculptural installation gradually taking shape in

my mind over the course of this project which embodies all that I have explored in this project, and once time allows, I will pursue this idea further. I would also like to further develop the blended technique of cold moulding and CADCAM methods researched during this project to explore its possibilities to be utilised in furniture and other designed objects.

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